OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as "developed", "industrialized" and "developing" are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

23539

NATIONAL CLEANER PRODUCTION CENTRE SA

NCPC
national cleaner production centre
South Africa

CONTRACT REPORT

QUICK-SCAN SUMMARY REPORT OF SAB LIMITED NEWLANDS

086DG / HY7AGRO

Prepared for:	**Mr Josiah Mpofu** **SAB Newlands** **No 3 Main Rd** **Newlands**
Prepared by:	**Mrs Zubeida Zwavel** **BECO Institute for Sustainable Business**
On Behalf of:	**Mr Mano Ram Reddi** **National Cleaner Production Centre** **P O Box 395** **Pretoria** **0001**

QUICK-SCAN SUMMARY REPORT OF SAB LIMITED NEWLANDS

Mrs Zubeida Zwavel

28 September 2007

DOCUMENT CONTROL

Degree of Confidentiality:	Client Confidential			
Title:	Quick-Scan Summary Report of SAB Limited Newlands			
Authors:	Mrs Zubeida Zwavel			
Date of Issue:	28 September 2007			
No. of Pages	31			
Issuing Organisation: National Cleaner Production Centre PO Box 395 0001 Pretoria RSA	Telephone: Telefax:	(Nat) (Int) (Nat) (Int)	(012) 841 3136 + 27 12 841 3136 (012) 841 5039 + 27 12 841 5039	
Contract Name:	UNIDO Demonstration Cleaner Production Programme			
Project Number:	HY7AGRO			
Keywords:	Cleaner Production			
Issue Number:	001			
Copy Number:	1			
Project Leader:	Ms. P Maepa			

APPROVED BY:

Responsibility	Name	Signature
Technical	Mrs Zubeida Zwavel, Dr J Fresner, Dr T Buerki	
Review	Mr M Ram Reddi	

DISTRIBUTION:

Company	Contact Person	Copy Number
SAB Newlands	Mr Josiah Mpofu	1 – 2
NCPC (File: 086DG / HY7AGRO		3

FILENAME, TEMPLATE AND VERSION CONTROL

D:\Quick Scan SAB Limited Newlands Final.doc. Created: 28 September 2007, from template:
I:\NCPC\Communications and Stakeholder Relations\NCPC Templates\Proforma Templates\Ext_Report NCPC.dot. Template revision 2, 3 May 2004.

CONTENT

1. INTRODUCTION....6
1.1 Background....6
1.2 Working Procedure....6
2. COMPANY DESCRIPTION....6
2.1 Company profile....6
2.2 Product range....7
2.3 Customers and suppliers....7
2.4 Location (Site Plan)....9
2.5 Management Systems....9
3. PROCESS DESCRIPTION....10
3.1 Raw material handling....10
3.2 Milling....11
3.3 Mash Tun....11
3.4 Lauter Tun....11
3.5 Wort Kettle....12
3.6 Brewhouse 1....12
3.7 Brewhouse 2....12
3.8 Whirlpool....13
3.9 Fermenting....13
3.10 Bottling and Packaging....14
4. SUB-PROCESSES....14
4.1 Transport....14
4.2 Storage and handling....15
4.3 Energy Management....15
4.4 Electricity Usage....15
4.5 Process Heat....15
4.6 Compressed Air....16
4.7 Refrigeration....17

4.8 Water Management 17
4.9 Water supply 18
4.10 Wastewater 19
4.11 Beer Losses 19
4.12 Solid Waste generation 20
5. FINDINGS OF THE QUICK SCAN 21
5.1 Methodology 21
5.2 Discussion of Results 22
5.3 Benchmark Comparison 23
5.4 Cleaner Production Improvement Opportunities 24
5.4.1 Improvement measures 25
5.4.2 Improvement options 25
5.4.3 Focus areas 26
6. CONCLUSION AND RECOMMENDATIONS 27
APPENDIX 1: RAW MATERIAL CONSUMPTION 28
APPENDIX 2: CLEANER PRODUCTION POTENTIAL 30
APPENDIX 3: REFRIGERATION SYSTEM 32

1. INTRODUCTION

1.1 Background

This report outlines the activities undertaken during a Prevention Quick Scan of the South African Breweries (SAB) manufacturing site in Newlands. The project is part of a Cleaner production Demonstration Project for the Agro processing sector coordinated by the National Cleaner Production Centre (NCPC).

SAB is one of the leading multinationals in South Africa and the third largest breweries in the world. It is therefore important that each subsidiary brewery of the group is able to benchmark themselves against international standards to ensure best practice. Therefore Cleaner Production aligns with the companies strategic goals. SAB Newlands are among the top 20 performers in the world. They have set targets for reduction of water, energy and beer loss reduction. All of which are part of divisional projects headed by various departments (Super Y projects).

1.2 Working Procedure

A consultant from BECO - Institute for Sustainable Business, Zubeida Zwavel, is part of a consulting team leading the Cleaner Production project. Support is provided by Thomas Buerki and Johannes Fresner of UNIDO. The project consists of two phases the Quick Scan (QS) and the In Plant Assessment (IPA). The Quick Scan aims to examine the potential for Cleaner Production to be implemented at SAB Newlands.

It requires close cooperation between the consultant and the participating company. Therefore a walkthrough was conducted at SAB Newlands by the consultant team and members of the engineering department. This was followed by request for information in the form of a questionnaire. The questionnaire was sent to SAB and a meeting was held with the engineering team to fill in gaps. Subsequently a meeting was also held with and engineer from the utilities department.

2. COMPANY DESCRIPTION

2.1 Company profile

South African Breweries Limited is part of South African beer operations of SABMiller plc. SAB has been operating since 1895 and holds a 98% market share in the South African beer market. Its portfolio is a careful balance of long-established, well-known brands such as its flagship Castle Lager, as well as new niche products. The company's seven breweries produce about 40 million hectolitres annually (beer and soft drinks). SAB's comprehensive distribution network plus its investments in both South African Breweries Hop Farms (Pty) Limited and Southern Associated Maltsters (Pty) Limited complete its operational facilities. The group owns all the brands it sells in South Africa, except for Amstel and Heineken. The table below provides the company details.

Table 1: Details of the company

Company Name	SAB Newlands Brewery

Contact People	o Estelle Cubbin (Lead process Engineer) o Josiah Mpofu (Engineering Manager) o Tyrone Chan (Process Engineer) o Peter Hofmann (Utilities Engineer)
Postal Address	PO box 23012 Claremont 7735
Telephone	021-6587511
Departments	o Brewing o Packaging o Logistics o Engineering o Quality o Finance o Manufacturing Systems o Human Resources

2.2 Product range

SAB's portfolio consists of 16 brands. The key brand is Castle Lager, which accounted for over 50% of the SAB's sales in recent years. Other major brands include Carling Black Label, Hansa Pilsener and Lion Lager. Both Castle Lager and Lion Lager have been established brands in South Africa since the beginning of the 20th century. Amstel, which is brewed and sold under licence from Heineken by SAB in South Africa, is the premium brand leader in South Africa. Heineken and Hofbräu Premium Lager complete the premium brand portfolio.

The beers brewed at SAB Newlands Brewery are:

1. Amstel
2. Carling Black Label
3. Castle
4. Castle Lite
5. Castle Milk Stout
6. Hansa Pilsener
7. Redds Premium
8. Redds Dry

2.3 Customers and suppliers

SAB Newlands operates as an intermediary division to the distribution of SAB therefore they do not operate directly with customers. Thus they view the distributing depot to be there direct customer. For this reason no revenue/turnover has been provided to SAB Newlands.

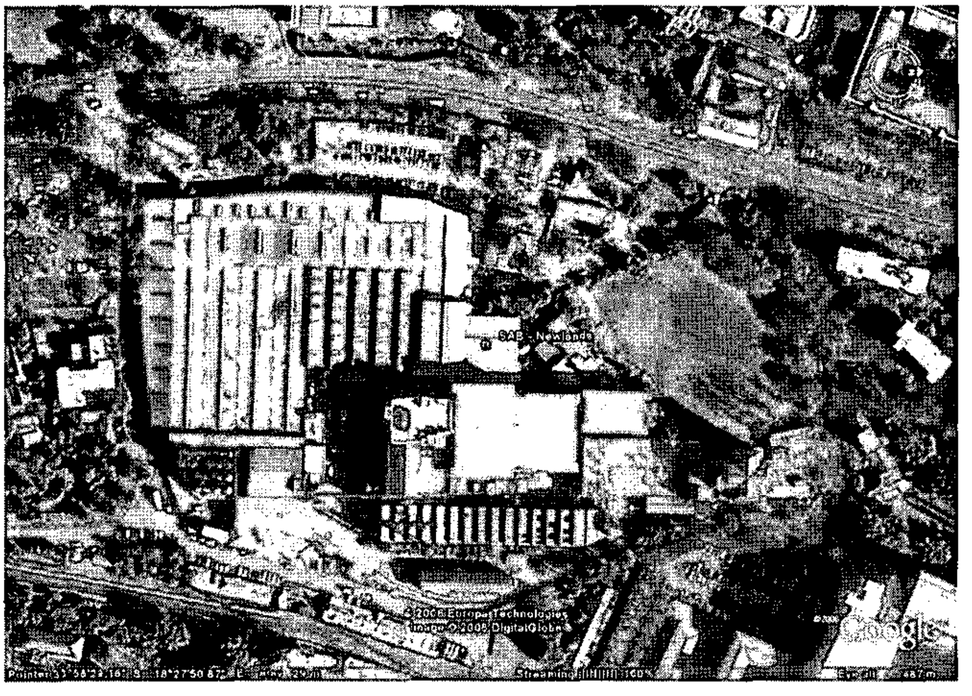
SAB Newlands have many suppliers the main suppliers are listed below with the material they supply. This list has been compiled with the engineering department. A list of raw materials and the consumption has been indicated in the appendix.

Table 2: List of main suppliers

Supplier	Material/service supplied
SAB Maltings	Malt
SAB Hop Farms	Hops
Afprod	Sugar and yeast
Consol	Glass Bottles
Coleus	Crowns
BevCan	Cans
Thutuka Labeling	Labels
Nampak	Packaging

2.4 Location (Site Plan)

The company is located in a semi residential/commercial area next to national sports field (Sahara Park). It is therefore important for the brewery to ensure that visual and noise impacts are kept to a minimum. The aerial picture below as well as the walkthrough indicates that SAB has limited space. It was mentioned that storage capacity is also limited and the location does not allow for optimum storage (i.e. storing materials close to the location of use).



2.5 Management Systems

SAB Newlands have implemented and certified their ISO 14000 system therefore they have formulated an environmental policy which has been communicated and published. Resources have been dedicated to environmental management as well as Quality, Health and Safety. The company has implemented an ISO 9001 quality management system as well as a NOSCA Health & Safety system.

The company has also established employee involvement schemes for new suggestions and improvements. They conduct detailed monitoring of process parameters for optimisation of processes. Daily reporting on key performance indicators (such as steam, water electricity usage) provide benchmarking information. Overall responsibility for environmental management has been assigned to senior management. Line functions have responsibilities in job descriptions and performance appraisals. Internal communication for reporting has been established.

3. PROCESS DESCRIPTION

The figure below outlines the process flow.

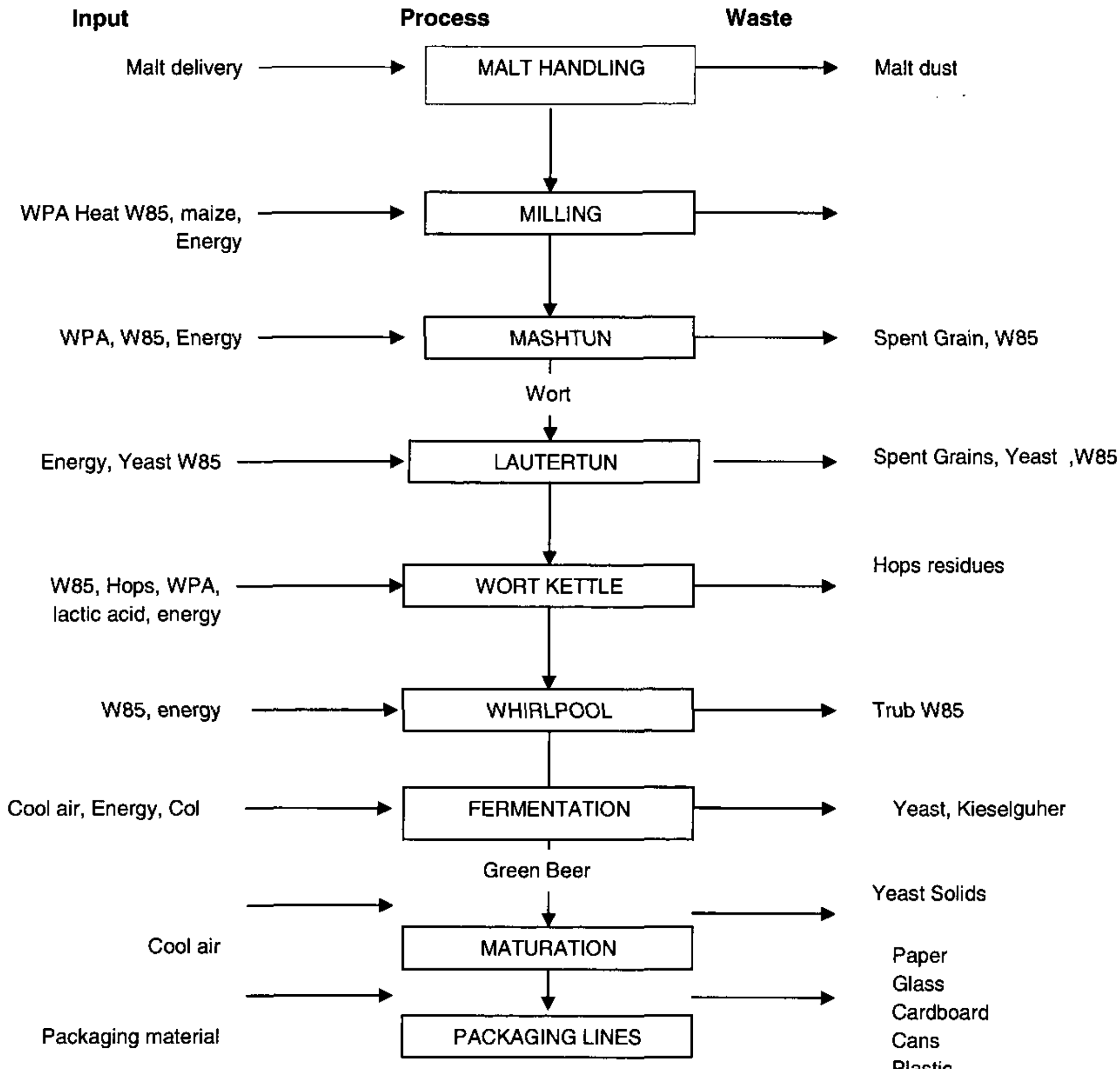


Figure 1: Flowchart of production process

3.1 Raw material handling

The malt is delivered by rail from Caledon from one of the group companies SAM and unloaded. Sometimes malt is imported and delivered from the harbour but this is kept to a minimum. The malt is then kept in hoppers after which it goes through a cleaning process to be destined. This process allows dust to be drawn off as well and the losses can vary from 1-4% depending on whether bad malt has been received from suppliers. The malt goes into storage tanks and the dust is transport to the bulk hoppers for it to be removed by the farmer for animal feed. From point of raw material entry to final product it takes 24 days.

3.2 Milling

There are three Mills in the Brew house. For each brew, two of the three Mills are used. At first, barley is prepared into *malt*. This malt and selected maize, comes into the Mills and passes through the conditioning chamber of the Mills. In this conditioning chamber it is steeped and it absorbs between 20 and 22 % water. The water is supplied by three big *hot water tanks* with water of 85º C (*W85*). Before this W85 water reaches the Mills, it is mixed with colder process water (*WPA*), resulting in water of 55º C. The malt is now crushed and steeped again. The crushed malt is mixed with more water in the mash pot below the crushing rollers and is pumped over to the Mash Tun. No air is pumped in with the *mash*. Losses can occur if the rollers have not been set up properly.

3.3 Mash Tun

The crushed malt and water mixture is called "mash". The Mash Tun is filled with the mash from the Mills. For about ten minutes the mash is heated by steam. The number of degrees to what it is heated is recipe (brand) specific. The heating stops and the Mash reach a temperature of about 63º C. At this temperature the enzymes become active. After a resting time, the Mash Tun heats up again for 9 minutes reaching a temperature of about 70º C. While heating, the starch will convert into sugars. The Mash Tun rests again and the mash now has a temperature of 72º C. When all the starch has been converted, the Mash Tun starts heating for the last time to about 76º C, which is the temperature when most of the enzyme activities will stop. The mash will be transferred to the Lauter Tun.

3.4 Lauter Tun

The liquid substance, which is separated from the mash, is now called "*wort*". First there is an underlet, whereby water comes in from the bottom of the Lauter Tun, the water is used to cover the false bottom and also to heat up the false bottom of the Lauter Tun. After that, the wort is transferred to the Lauter Tun. During the "first wort", the liquid wort is separated from the solid grains through the sieve and filter. At this stage most of the liquid wort is separated from the solid grains.

During the "second wort", more wort will be separated from the grains by washing. With every second wort, a spurge with water takes place, using hot water (77º C) and recovering the maximum amount of fermentable sugars. The second wort starts with a very short spurge, followed by another short spurge. The "waste" wort goes to drain through the sweet wort tank.

The grains, called "spent grains," are collected and are swept into a hopper below the vessel, where after they are transferred to silos. At last, they are sold to farmers to be used for feed. After this spent grain removal, the Lauter Tun starts to rinse for about 3 minutes, followed by draining. The wort is transferred to a holding vessel called the Underback.

3.5 Wort Kettle

As soon as the Wort Kettle is ready, the wort from the Underback is pumped into the Wort kettle. One of the functions of the Wort Kettle is to concentrate the wort. Another function of the Wort Kettle is boiling the extract aroma and flavour substances from the *hops* used. The boiling systems are different in Brewhouse 1 and 2. Brewhouse 1 has its boiler inside and Brewhouse 2 has its boiler outside the Wort Kettle, but both are operated by steam. The temperature of the boiler and the wort temperature is not allowed to be very different, because otherwise the wort will burn. This is the benefit of an outside boiler, because it has a bigger surface area. During this stage there are about 1.8 % beer losses.

3.6 Brewhouse 1

Boiling kills any microorganisms present in the wort and sterilize the wort. Top water is added automatically, while heating up for about 45 minutes. When the wort reaches 80º C, the liquid adjuncts are pumped over from the batching tanks. Also the lactic *acid* is dosed into the kettle, to adjust the pH to a value that is favorable for protein precipitation. When the wort reaches 96º C, the operator has to add the hops. When this is done, the kettle is heated up till 98º C, where after the kettle starts boiling; for Amstel this is 90 minutes and for all the rest it takes 60 minutes. The time for the addition of hops is based on elapsed boiling time, which is started as soon as the temperature set point for the wort is achieved. When the boiling is finished, the wort rests for about 5 minutes. After the resting period, the operator checks the gravity of the wort as well as the hops dosing vessels. If there are hops left it has to be removed. The wort is pumped over to the next vessel, the Whirlpool. The pumping over takes about 30 minutes and after that the cast-out pump is started once the wort inlet nozzle into the whirlpool is covered with wort. Once the low level indication in the vessel is reached, the pumping is stopped. The hop vessels are flushed with a quantity of water. After that the internal boiler and the kettle is flushed with the remaining quantity of water and followed to drain at last.

3.7 Brewhouse 2

As soon as the wort transfer from Underback to the Wort Kettle begins, a set amount of top up water is added to the kettle. This is always an amount of around 70 hl. At the end of the transfer the used water is also added. This amounts the maximum of 634 hl minus the actual added amount of water in the previous step and differs from brew to brew. The wort is heated by steam to 97 º C.

When this temperature is reached, W85 water is coming in with a standard flow. To circulate the wort and in doing so more evenly heat the wort up, it is pumped through an external wort heater (heat exchanger). When it is boiling, there is gas and liquid. The thermosyphon effect starts. The pumping stops and the thermosyphon valve is open; the gas will push the liquid up. When the wort is boiling there is no pump used, because the gas pushes the liquid upward. While pumping over, salts are added to the wort, the same as in Brewhouse 1. The wort is brought to 98º C.

There is no operator step in Brewhouse 2 and the kettle will immediately start to boil. The next 60 minutes the wort is boiled at 100º C. Hops are added. After this, the Wort Kettle prepares for pumping the wort over to the Whirlpool. The CIP of the density meter starts now. And at last the wort is pumped over to the Whirlpool. Water of the W85 tanks is used to rinse the vessel and after that the Wort Kettle drains.

3.8 Whirlpool

The wort goes into the Whirlpool to collect the unwanted materials. The liquid has a temperature of about 100º-95º C. The initial process starts now for about 70 minutes. The pumping over to the whirlpool happens tangentially, which causes the wort to swirl and the trub to settle out in form of a cone, to the middle of the Whirlpool. The unwanted materials, called "trub," are collected at the bottom of the Whirlpool. The trub is unwanted, because it contains a lot of carbon dioxide. The wort is rinsed, where after the wort is sprayed, followed by trub removal. The trub acts as a preservative for the spent grains as animal feed.

The exiting wort has to be cooled down as soon as possible and therefore it goes into the chiller. *Chill liquor* of 4º C comes into the heat exchanger and cools down the wort to 10º C. The exiting hot water goes back to the W85 tanks. The trub goes into an intermediary vessel called trub tank, before being added to the spent grain in the Lauter Tun to be used as feed. At last, the liquid is pumped over to a Fermenting Vessel and the Whirlpool drains.

3.9 Fermenting

During the way, from the Whirlpool to the Fermenting Vessel, oxygen is added. Only here in the process oxygen can be added. Yeast and yeast food with lots of nutrients is also added to the wort. Fermentation allows for 3% losses which are due to physical and biological process of fermenting.

Fermenting vessels

In the Fermenting Vessel the yeast converts the sugars into alcohol and Carbon Dioxide.

Sugar + yeast → alcohol + Carbon Dioxide

The Carbon Dioxide gets caught up in this process and put ina its liquid form for reuse in a later process.

As soon as there is alcohol, the liquid is called beer. The beer stays in the Fermenting Vessel for about ten days. The yeast drains at the bottom of the Fermenting Vessel. Because not all the yeast is seperated from the beer, a centrifuge after the Fermenting Vessel will remove the remaining yeast. Only a part of this can be used again, so the other part has to be dumped.

Storage vessels

The beer goes into the Storage Vessels, where it stays for about four days to mature, after which it is at its full potential and is called "green beer." The tenperature ranges between -1 to 1 deg C. During storage there would be approximately 1% losses.

Filtration

After this four days of maturing, the beer needs to be filtered. The filtering is done to remove the last remaining yeast. Most breweries use other filter material, but SAB use kieselguhr filter. After filtration the beer is transfered to the Bright Beer Tank, after which it goes to Packaging. The D-plant is situated in this area which adds carbonated water to the beer.Filtration allows for another 1% of beer losses.

3.10 Bottling and Packaging

Now that the brewing process is completed, the finished beer is pumped to the bottle shop and the packaging process begins. It has taken approximately 24 days to reach this point in the process. The packaging process adds another 1-1,2 % of losses. There are four packaging lines at the site.
Before filling, the bottles are subjected to a thorough soaking in caustic soda solution baths at high temperatures, the caustic strength varying from 5% down to 0%. The bottles are rinsed under a high pressure system and rendered sterile. Systematic bacteriological analysis ensures the efficiency of the system. The bottles pass along a conveyor system from the soaker to a filling machine. Any dirty or chipped bottles are removed at visual and electronic sighting stations located between the soaker and filler.

At the filler, a counter pressure of carbon dioxide is applied on the bottle. The beer is located in the filler bowl above the filling stations and is also held under counter pressure. After the counter pressure is placed on the bottle, and the bowl and bottle pressures have been equalized, the filling arm is tripped and the beer is run into the bottle by gravity. When the bottle is full slight foaming occurs, excluding oxygen from the top of the bottle and the bottle passes to the crowning stations for closure. The crowns are automatically placed on the bottle and under spring power; the crowner crimps the closure ensuring a perfect seal. The bottle continues from the crowner to the pasteurizer.

The bottles pass on a continuous moving table in the pasteurizer under a constant spray of heated water. It takes approximately 30 minutes to complete the pass through this machine; approximately 10 minutes to warm the beer to pasteurizing temperature, 12 minutes at 60℃ through the pasteurization zone and an additional 8 minutes to cool the beer down to approximately ambient temperature. Accurate temperature control is essential to prevent unpleasant "cooked" flavours in the finished beer.

The pasteurized bottle of beer then passes a second visual inspection (foam picker) that removes any remaining imperfect bottles, preventing their admittance to the trade. An automatic labelling machine affixes the labels, followed by an electronic scanner which removes any bottles which are over or under filled, and lastly, an ink jet date coder which stamps the date and time of production on each bottle. The bottles are then packaged in cartons, sealed and the cartons coded. The carton continues along conveyor belts to the palletiser.

4. SUB-PROCESSES

4.1 Transport

The breweries have a logistics department on site that does the planning for transport routes of goods. Therefore the transport of goods is optimised and continuous improvement is built in. Most transport takes place via road while the malt is delivered by rail from Caledon or when imported it is transported from the harbour. The transport is mostly outsourced to third parties but the off-loading and on-loading of goods is done by SAB personnel. Contractors are informed about Occupational Health and Safety standards with regular audits and walkthroughs take place. SAB do not get involved in employee transport only during shifts when public transport is not operating.

4.2 Storage and handling

All storage is optimised and handling of goods is minimised. Bulk storage places such as silos and hoppers for grains and temporary storage of wastes were observed during the walkthrough. It was mentioned due to limited space the storage cannot be optimised further. This is continuously looked at by the logistics department. The storage departments were not shown in detail.

4.3 Energy Management

Energy is mainly managed by the utilities department within the Brewery. Regular reporting and accounting takes place within the brewery with target figures for each department. These figures are also used for benchmarking purposes. The energy types used at SAB is electricity provided by the City of Cape Town municipality and Heavy Fuel Oil supplied by FFS. AT the time the report was submitted no monthly figures were given for electricity consumption.

4.4 Electricity Usage

In 2005/6 the electricity consumption at SAB was 35 819 754 kWh with an average monthly kVA of about 5000. In total SAB paid a price of approximately R 6 million for there electricity usage. The average price is about 14 cents per kWh and R 20 per kVA. This cost excludes the electrode boiler as this is contracted to EB steam. The highest electricity consumer is the refrigeration system.

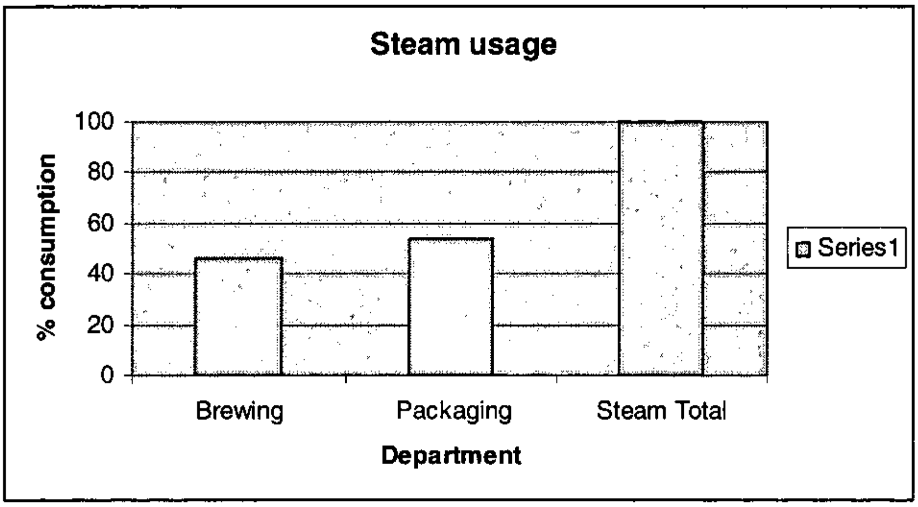
4.5 Process Heat

The majority of the steam consumption for the site is produced by an electrode boiler which is operating 97% of the time. The total steam consumption for the year is approximately 410 000 tons. SAB (Newlands) outsource their steam generation to EB steam which charges them R70 per ton of steam production. Thus they only pay for the amount of steam used. Steam is used in the factory for the following applications:

- Heating of water
- Pasteurizing
- Sterilising
- Etc.

The electrode boiler is about 40 MW electric and delivers 55 tons of steam an hour. The two standby boilers are HFO boilers which are on warm standby with only hot water and HFO circulating in the system to keep it warm. These boilers have capacity of 20 tonnes. A methane gas recovery project is underway which would use the methane to generate steam and produce about 1.5 tonnes/hr. The utilities department is working on 2 projects 1)

Figure 2: steam usage



4.6 Compressed Air

SAB makes use of 4 air compressors. The compressor has three systems; an air system that provides the product, a water system for cooling purposes and an oil system for lubrication of the valves. The accumulator pressure varies from 5.9 -6.7 bar. Compressed air is used throughout the process in the following ways:

- In the fermenting tanks comp air is used to remove the CO_2 from the tanks
- In the packaging comp air is used to dry the bottles after they come out of the bottle washer.
- Removing spent grains form the tanks.

During weekdays, the two large compressors (ZR4) are online. Usually, only one in operation at a time is sufficient to supply the factory with enough compressed air, but during peak hours two units are in operation. When the one compressor is online at one day, the next day the other one is online. There is production during weekends, but not as much as during weekdays. Therefore the two small compressors (ZR3) are online to supply compressed air (20 m3/min). If the need for compressed air is higher then both small compressors can deliver, a ZR4 is switched on as well (38 m3/min). Because there's always at least one compressor off-line, this one counts as the backup compressor. No load sharing takes place throughout the system

Table 3: Compressor data

Newlands Brewery Air Compressor Data

Information needed	First type	Second type	Third type
Compressor type	Atlas Copco ZR3-53	Atlas Copco ZR4-52	ZT55
Compressor application	Air	Air	Spent grains Air
Mode of compression – Centrifugal, Piston, Rotary screw etc	Oil free Rotary Screw	Oil free Rotary Screw	Oil free Rotary Screw
Number of Compressors	2	1	1
Compressor Air volume M3/minute	19.5 at 8 bar	38.7 at 8 bar	7.5 at 6 bar
Motor size – KW	132	250	55

4.7 Refrigeration

SAB uses a lot of cooling in their processes. Processes where cooling is used are for example:

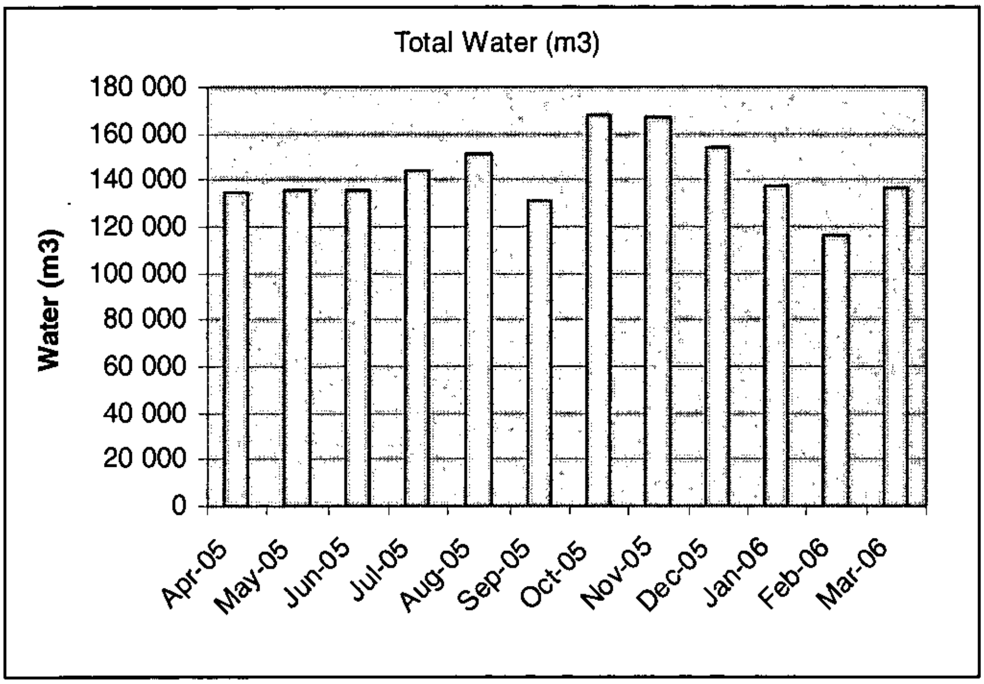
- Cooling of wort to fermentation
- Cooling of fermentation tanks
- Cooling of storage vessels

Thus one of the biggest electricity users for the utilities department is the ammonia compressors. Appendix 2 shows the refrigeration system.

4.8 Water Management

Water reduction is one of SAB Newlands main projects. They would like to reduce water by about 15% from 4,2 hl/hl of beer to 4.0 hl/hl. Water is used in most departments from brewing to packaging. They also use water for their Cleaning In Place (CIP) systems. The CIP station is an automated centralized plant, used to store and supply detergents to Brewhouse 1 and wort main 1 at the required temperature and concentration. The total water consumption is 1 700 000 m^3 per year.

Figure 3: total water consumption per month



Month	Total Water (m^3)
Apr-05	134 983
May-05	135 347
Jun-05	135 839
Jul-05	143 924
Aug-05	151 725
Sep-05	131 428
Oct-05	168 373
Nov-05	166 801
Dec-05	153 978
Jan-06	137 505
Feb-06	116 694
Mar-06	136 299
Total	1 712 896

4.9 Water supply

South African Breweries in Newlands uses water from different sources. These water supplies are springs, boreholes and municipal. The water from the boreholes has to be adjusted with chlorine (WCA). The major users of WCA are as follows: Packaging, Ferment cellars, Foam trap, Filtration, the electric boiler feed water and the Condensers. WPA is the process water, which is mostly used in the brewing process. The major users are as follows: Brewhouse 1 and 2, Ferment, Filtration and to make chill liquor. The brewery uses mainly water from the boreholes and springs therefore they do not pay for this water.

4.10 Wastewater

Most of the water goes to the wastewater treatment plant which gets treated before being transported to the municipal wastewater system. The CODs of the treated effluent are between 500-600 mg/l. The effluent plant is an anaerobic digester which produces biogas as one of the by products. The remaining sludge is taken to a farmer for soil conditioning. Biogas consists of approximately 85% methane gas. At the moment this biogas is being flared. SAB Newlands has investigated ways of using this gas. Some of the uses that they have already been investigated are the following:

- Steam generation
- Absorption cooling
- Combined Heat and Power system
- Using it as a hot water system for heat generation.

SAB has chosen using the methane to be fired in a boiler to generate steam. The municipality charges SAB for the effluent of which comes to approximately R 2.4 million per year. The internal operating costs for the wastewater treatment plant have not been provided.

4.11 Beer Losses

Losses occur throughout the process and may occur due to the following generic reasons[1]:

- Emptying *of process tanks.* After the tanks are emptied some beer will remain. The amount depends on the efficiency with which the emptying is controlled.
- *Kieselguhr filter.* At the beginning of a filter run the filter will be full of water that is pushed out with beer. At the end of a filter run the beer is pushed out with water. These pre-runs and after-runs result in a mixture of beer and water.
- *Pipes.* When beer in the process pipes is pushed out with water, a mixture of water and beer will occur.
- *Beer rejected in the packaging area.* Beer can be rejected due to for example wrong filling height and no or incorrectly placed labels. The number of rejected bottles will depend on the brewery's quality requirements and the equipment.
- *Returned beer.* Beer may be returned to the brewery if it has not been sold or if the quality is not acceptable.
- Exploding *bottles in the packaging area.* The bottles explode due to poor quality of the bottle, poor bottle inspection or lack of temperature control in the tunnel pasteurizer.

As per conversation with SAB typical losses vary between 9-11% of which they strive to keep it as low as possible. The following estimated losses occur throughout the processes.

[1] These reasons have been outlined by the BREF documents

Process step	% losses
Material handling (transfer losses)	1%
Brewhouse losses	1.8%
Fermentation losses (biological/physical)	3%
Storage losses	1%
Filtration losses	1%
Packaging losses	1.2%
TOTAL ESTIMATED LOSSES	9%

The table below indicates the only transfer losses account to over R 4,6 million of raw materials.

MATERIAL	*Unit Cost*	*Units*	*Usage*	*Transfer losses*	*TOTAL*	**Raw material cost of transfer losses**
Brewing						
Malts						
North American SAM	4.15	kg	24,252,285	500,148	24,752,433	R 2,075,614
Heineken	3.89	kg	2,864,240	61,144	2,925,384	R 237,850
Black malt imp	5.41	kg	41,521	1,112	42,633	R 6,016
Southern Hemisphere SAM	4.15	kg	11,400,724	181,658	11,582,382	R 753,881
Adjuncts						
Maltose	7.8	kg	4,723,057	92,319	4,815,376	R 720,088
Dextrose	2.91	kg	19,203,342	277,564	19,480,906	R 807,711
Caramel	7.45	kg	15,177	455	15,632	R 3,393
Lactose		kg	850			
					TOTAL	R 4,604,553

4.12 Solid Waste generation

Solid waste is generated throughout the process and set procedures have been outlines for waste stream. By-products such as spent yeast, grains and trub are produced during the process most of which goes to a farmer for animal feed. Some of the spent yeast is added to the anaerobic digester as a thickener. At the moment the Kieselguher filter is removed as a hazardous waste which adds to the high waste disposal costs. Most of the packaging and general waste is being recycled by a contractor who manages SAB Newlands' waste. The table below indicates the manner in which each waste type is being disposed of. Disposal costs and amounts of wastes have been requested but have not been provided at the time the report was submitted.

Table 4: Waste Disposal methods

Waste type	Kind of waste	Disposal method
Spent Grains	Process waste	Sent to farmers for feed to animals
Yeast	Process waste	Sent to farmers for feed to animals
Kieselguher	Process waste	Waste disposal company removes it as hazardous waste
Trub	Process waste	Sent to farmers for feed to animals
Broken Glass	Packaging waste	Separate amber, green and clear glass into the bins provided. Then removed by the recycling company Enviroglass.
Cans	Packaging waste	When containers are full, they will be removed by the recycling company.
Plastic	Packaging waste	When containers are full, they will be removed by the recycling company.
Plastic crates	Packaging waste	Plastic crates will be re-used, when broken, the will be recycled.
Pallets	Packaging waste	Pallets will be re-used, when broken the will be given away.
Carton & cardboards	Packaging waste	The cartons will be collected, When full, they will be removed by the recycling company
Scrap metal	General waste	When full, they will be removed by the recycling company
Office paper	General waste	When the box is full, boxes are removed and taken to paper recycling company.

5. FINDINGS OF THE QUICK SCAN

5.1 Methodology

The data collected during the company visit was evaluated with the software-tool *Eco Inspector*. The CP potential of individual process steps, including those covering the sub processes was examined in accordance with the following criteria:

Inputs:

- Are there any problem materials which are hazardous to the environment or to health?
- Are large volumes of raw, auxiliary and operating materials used?
- Is the level of energy consumption high?
- Are major costs incurred on the input side (materials or energy)?

Outputs:

- Are large volumes of (problematic) waste, special waste, wastewater, wastewater components or emissions generated?
- Are high internal/external preparation and disposal costs incurred?

Technology:

- Is the applied technology state of the art?
- What is the level of automation?
- Are there losses incurred through faulty batches or scrap?
- How are the systems serviced or cleaned?
- Are high costs incurred for maintenance, cleaning, and stoppages?

Each process step was qualitatively checked on these criteria and was classified according to the following scale:

Potential Points – Assessment of Potential Level for Each Criterion

Criterion not applicable to this process area, or no CP potential	Zero points
Moderate CP potential anticipated	1 point
Significant CP potential anticipated	2 points

The next step examines each sub-process as an entity according to the scale in Table 2 to determine the actual level of optimization already achieved; i.e. whether or not the CP potential is already exhausted. Thus the "relevance" of the identified potentials is described and a weighting factor is defined. This is a qualitative estimate and draws on the experience of the person conducting the Quick-Scan (expert opinion).

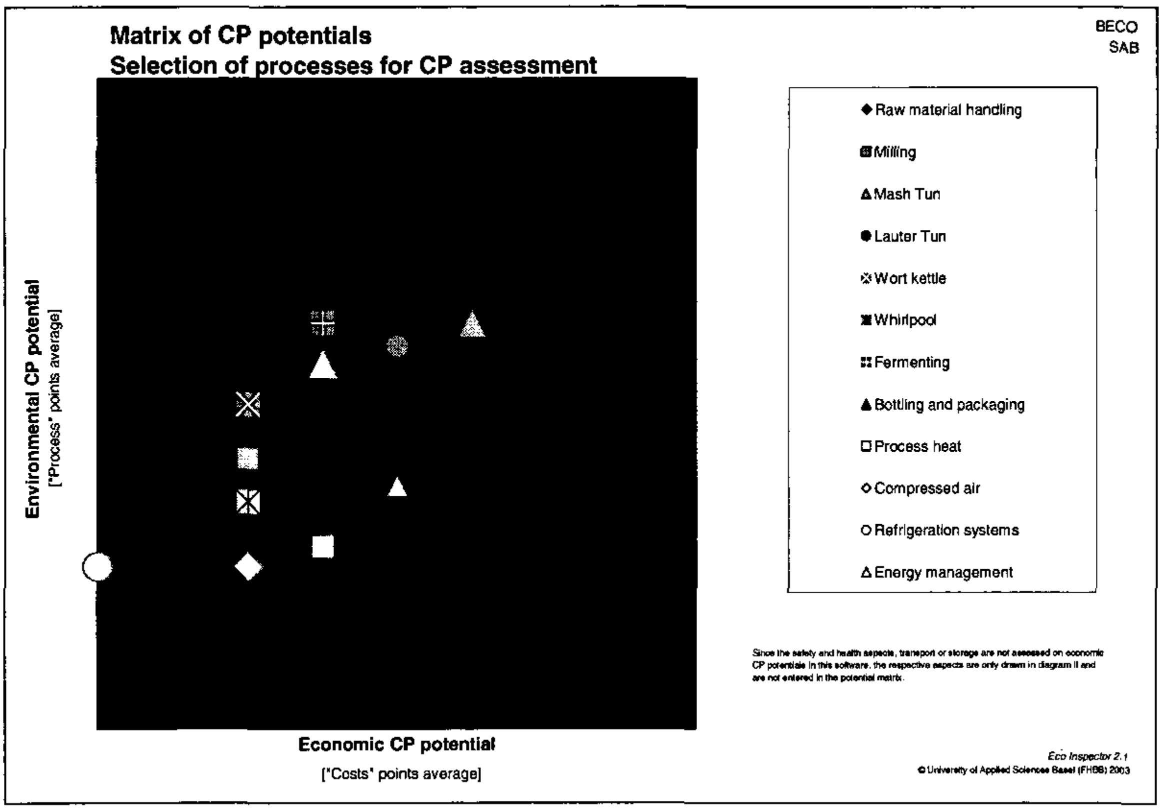
Scale for Estimating the Level of Optimisation of the Current Process (weighting factor)

Level of optimisation "high"	Optimisation potential largely exhausted	0 Points
Level of optimisation "high to medium"		0.5 Points
Level of optimisation "medium"	Optimisation potential not fully exhausted	1.0 Point
Level of optimisation "medium to low"		1.5 Points
Level of optimisation "low"	Non-optimised process step	2.0 Points

The product of the potential point and weighting factor indicates the current CP potential for each criterion point of each sub-process. The average of points for the individual categories (Inputs, outputs, technology and cost) gives a benchmark for the CP potential of individual process steps. This enables a rapid comparison of the sub-processes and facilitates selection of the processes for more detailed analysis.

5.2 Discussion of Results

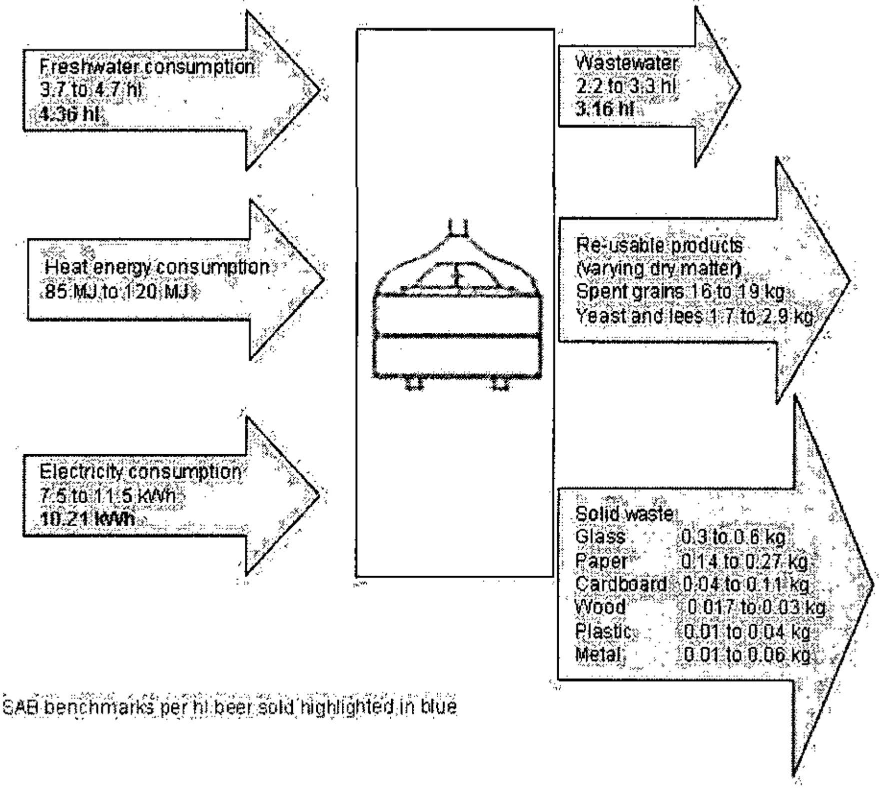
The graph shows that the bottling and packaging has the highest potential for Cleaner Production due to the potential of reusing the water. Energy management is well optimised with preventative maintenance and regular audits in place. The Lauter Tun process can also be optimised due to the spent grain removal. Solid waste and wastewater has been incorporated in each process step.



5.3 Benchmark Comparison

SAB Newlands prides themselves of being amongst the top 20 breweries in the world and tries to reduce their energy, water and losses continuously. With this they benchmark amongst each other within SABMiller as well as with international benchmarks. The benchmarks below have been taken from the Best Available Techniques (BREF) documents which set the EU standards for cleaner production and technologies. The benchmark data in blue have been derived from a report received from the utilities department providing the figures for the year to date of 2006. The figure indicates that SAB Newlands have done well as they have varied products but can still improve within electricity and water consumption.

Figure 3: Benchmark data for breweries above 1 million Hectolitres per hl of beer sold



5.4 Cleaner Production Improvement Opportunities

SAB has implemented a programme for their strategic projects within water and energy management as well as beer losses. Various projects are underway and a few of the options provided within the paragraphs below might link with these options. The Cleaner Production opportunities have been divided into separate categories, improvement measures, improvement options and focus areas. Improvement measures can be implemented immediately with little or no investment costs associated to it. An improvement option requires a feasibility analysis to investigate whether it can be incorporated into the company. The last category is focus areas, which highlights process specific areas that require a detailed assessment. Options have been identified as per interviews with CP experts, form experience and research with documents such as BREFs[2].

[2] Best Available Techniques Reference documents (BREFs)have been developed by the IPPC and can be found on the website http://eippcb.jrc.es/pages/FActivities.htm

5.4.1 Improvement measures

- According to our knowledge the Kieselguher is not a hazardous material and should not be disposed of as hazardous waste. The material can be reclassified and disposed of as general waste and at the same time reused within the cement industry. This could save SAB high amounts in disposal costs.

5.4.2 Improvement options

- At present 65-75 % of condensate is being returned. One of the quickest ways to save energy on steam is to *recover* the condensate. With this you can save significant amounts of energy. This option should be investigated further.
- The bottle-washing process is optimized for the 750 ml bottles but not for the smaller 375 ml. Therefore a lot of water is lost due to only having one setting. The optimization of having a dual setting for different size bottles should be investigated. It should be noted that new modern bottle washers have a much lower energy and water consumption than older machines. (The water consumption for a modern bottle washer is around 0.5 hl/hl bottle volume. Water consumption figures of 3 - 4 hl/hl bottle volume are not unusual in the case of older bottle washers.)
- Clean water is used for *bottle* washing and crate washing. It is quite common to use water from the bottle washing process for crate washing. A discussion with the process engineer indicated that this was conducted at the one of the subsidiary breweries of SABMiller (Rosslyn) but sedimentation was found. A detailed study of why this occurred should be investigated as it may be feasible for the Newlands brewery.
- A lot of compressed air is being used to clean tanks, both in the fermenting cellars and in the brew house, causing a lot of energy being spilled. There's not much to do about the fermenting cleaning, because this is a process that needs to use air. Spent grain removal in the brew house however is not subject to the use of compressed air. It would be possible to clean the tanks in another way. Maybe a belt conveyor or a progressing cavity pump is a better solution.
- In order to meet the process requirement for the wort boiling it is required to heat and boil the wort. The wort is *transferred* from lautering at a specific temperature and a gravity, which varies depending upon the sparging of the mash. The energy consumption will, therefore, depend upon the gravity and the gravity before and after boiling and the evaporation required to remove unwanted flavour components. A reduction of 1% of the evaporation rate will result in a 2.2 MJ/hl wort reduction.
- It is assumed that insulation is constantly looked at due to the many heating and cooling processes. Therefore *insulation* is quite important and should constantly be looked at during the preventative maintenance program.
- The evaporating temperature of the cooling plant is often lower than necessary. The requirement from the processes to the cooling plant is that it must be able to cool the beer to about -2℃. An evaporating temperature of *around* -6 to -8℃ is sufficient, but often the cooling plant is designed for a much lower evaporating temperature. An increase of 1℃ in evaporating temperature will reduce the electricity consumption for the cooling plant with 3 - 4%.
- The pressure in the compressed air system should be as low as possible. If the pressure is lowered from 8 bars to 7 bars, the *electricity* consumption for the compressors will drop 7%. A

heat recovery unit can recover 95% of the electricity consumption for a compressor. However, there are other types of waste heat in a brewery that can be recovered more easily.

- Installation of a recirculation tank for your vacuum pumps will reduce the water consumption by approximately 50%. The investment will be minor and should be evaluated.
- Weak wort can be collected in a tank equipped with heating jackets and a slow speed agitator and used for mashing in the next brew. This is particularly important for high gravity brewing. It reduces the organic load in the wastewater and will save raw material and water.
- Malt and adjunct dust represents a loss of extract. If collected it can be conveyed to the mash or adjunct kettle and the extract recovered. The dust should, therefore, be collected in connection with unloading of malt and *adjunct* and from the pneumatic transport of malt / adjuncts. The application of malt / adjunct dust re-use is limited to brew houses with mash filters as the insoluble parts of the dust otherwise will not be removed from the wort.
- It is suggested to focus on the handling of malt as the losses of incoming material could be as high as 4%. The combi-*cleaner* used for cleaning the malt should be optimised to remove stones only as too much dust is being removed.

o Overfilling of containers—cans, bottles or kegs—means product down the drain. It increases the loading on the effluent plant and wasted product which could otherwise be sold. Overfilling also means product given away. The cost of the odd bottle or can adds up to a huge cost for a year's production. All packaging lines should be analyzed using Statistical Process Control and identified areas of potential improvement. Waste can be easily reduced by calibrating filling apparatus, ensuring fill detectors are working properly and working to standard operating procedures.

- After the extract boiling stage, unwanted solids are removed in a whirlpool but a high percentage of valuable extract could also be removed. The trub (the removed solids and extract) was sent off site as animal feed. Eextract can be recovered from the trub and returned to an earlier production process. Unwanted solids can be removed with the spent grain and extract loss is almost eliminated from the whirlpool separation stage.
- Ice slurry technology-PLEASE PROVIDE DETAILS

5.4.3 Focus areas

- Hot water consumption is one of the key issues in regard to energy savings. Hot water is normally produced in a heat exchanger when cooling down the wort from 100℃ to the fermentation temperature (about 10℃). The hot wate r is stored in insulated (hot) water tanks and used for mashing of the next brew. If hot water is used for mashing only, there will be an excess of hot water giving an overflow from the hot water tank. Large amounts of water and energy can be lost due to this overflow. To optimize the hot water system, a hot water balance should be made for the entire brewery.
- It was found that although energy accounting takes place the amount of energy used by each department is not exactly known (for example the different packaging lines). It would be necessary to increase energy metering around the factor to allow for more accurate measurement of consumption. Anomalies such as energy use is increasing faster than your product sales, you may need to look for additional energy conservation opportunities.

- Overall beer losses range between 9-11% which is a concern as this could be optimised. Typical beer losses could be reduced to 8% which is more common in the EU. This is already a focus of SAB and forms part of their Super Y projects.

6. CONCLUSION AND RECOMMENDATIONS

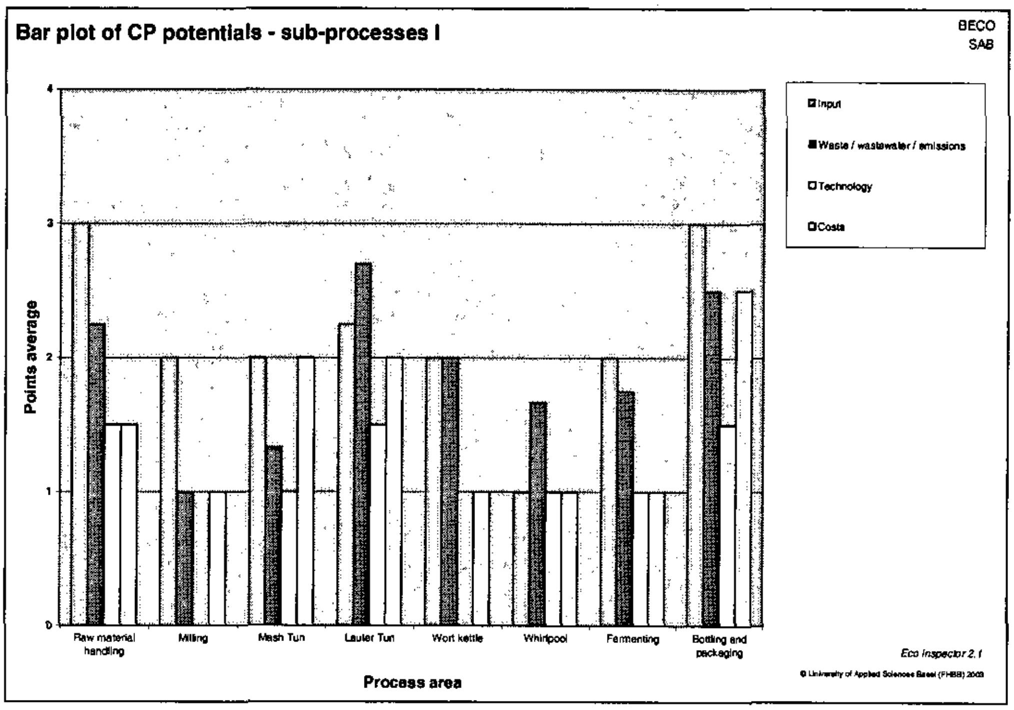
The results obtained shows that there is potential for implementing Cleaner Production. An in-depth study of the different possibilities of Cleaner production must be done, by means of a feasibility analysis of the different improvement opportunities. Some of the improvement options mentioned in section 5.4 are common to breweries and may not be applicable to SAB Newlands however it will be discussed during the presentation. The next step would be for SAB to decide which areas they would like to focus on for investigation and a feasibility analysis would take place for that specific area. The project will then go into the next phase, the In-Plant assessment.

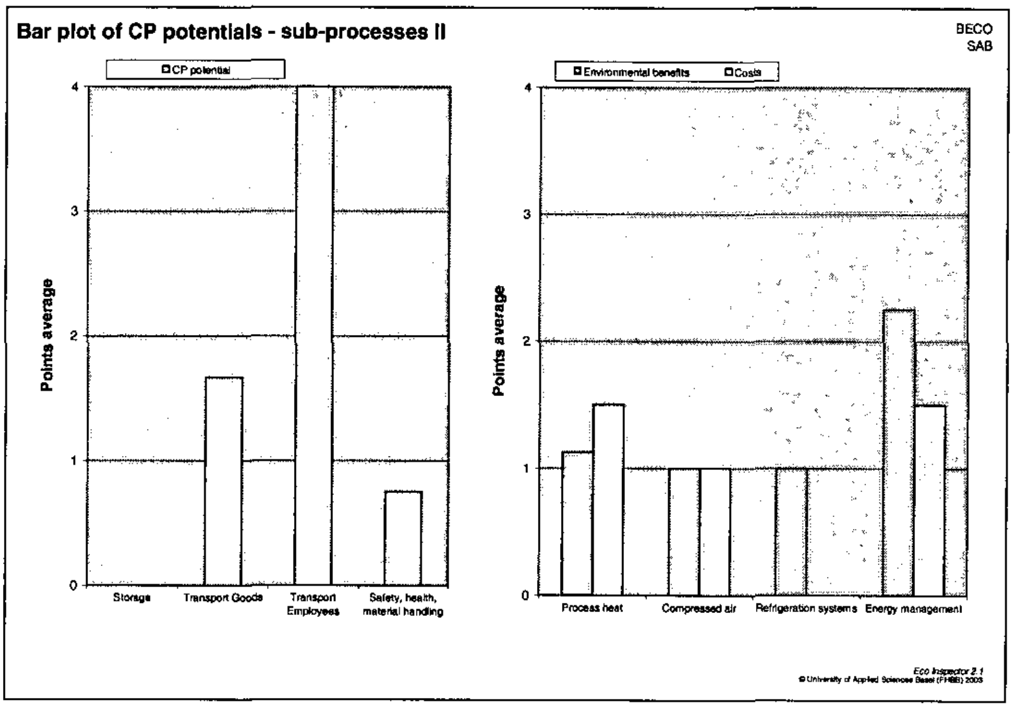
APPENDIX 1: RAW MATERIAL CONSUMPTION

Material	*Unit cost*	*Units*	*Usage*	*Transfer losses*	*Total*
Malts					
North American Sam	4.15	Kg	24,252,285	500,148	**24,752,433**
Heineken	3.89	Kg	2,864,240	61,144	**2,925,384**
Black malt imp	5.41	Kg	41,521	1,112	**42,633**
Southern hemisphere Sam	4.15	Kg	11,400,724	181,658	**11,582,382**
Adjuncts					
Maltose	7.8	Kg	4,723,057	92,319	**4,815,376**
Dextrose	2.91	Kg	19,203,342	277,564	**19,480,906**
Caramel	7.45	Kg	15,177	455	**15,632**
Lactose		Kg	850		
Brewing m&p sundries					
Calcium sulphate	3.14	Kg	88,674		**88,674**
Lactic acid	11	Kg	59,383		**59,383**
Calcium chloride	3.68	Kg	5,013		**5,013**
Brewing cleaning in process					
Brewing caustic	3.43	L	90,951		**90,951**
Brewing acid	3.2	Kg	26,110		**26,110**
Oxidising cleaner	16.57	Kg	925		**925**
Fermentation					
Cleaning in process					
Ferment caustic	3.52	L	305,560		**305,560**
Ferment acid	3.2	L	37,618		**37,618**
Ferment sterilant	3	L	6,296		**6,296**
Fermentation m & p's					
Oxygenation	7.4	Kg	10,423		**10,423**
Yeast nutrient	12.82	Kg	11,578		**11,578**
Storage & filtration					
Cleaning in process					
Storage caustic	3.56	L	20,168		**20,168**
Storage acid	3.2	L	26,241		**26,241**
Storage sterilant	11.6	L	7,583		**7,583**
Filtration primings					
Liquid sugar	2.88	Kg	1,055,623		**1,055,623**
Flavour -white wine	87.9	L	1,043		**1,043**
Flavour -dry apple	60.34	L	749		**749**
Flavour-red wine	97	L	353		**353**
Usage - filtration m & p's					
Malic acid	13.1	Kg	25,950		**25,950**
Polyclar regen	1767.15	Kg	113		**113**
Aspera malt extract	38.79	Kg	737		**737**
Caustic regeneration	6.5	L	9,650		**9,650**

Material	*Unit cost*	*Units*	*Usage*	*Transfer losses*	*Total*
Caramel	8.32	Kg	2,289		**2,289**
Citric acid	7.92	Kg	4,622		**4,622**
Acid regeneration	3.12	Kg	7,130		**7,130**
Alidex	4.03	Kg	65,076		**65,076**
Filtration materials					
Kieselguhr – hyflo	6.78	Kg	207,219		**207,219**
Kieselguhr – ssc	6.78	Kg	202,268		**202,268**
Kieselguhr – 577	6.78	Kg	10,986		**10,986**
Trap filters	240.87	Ea	185		**185**

APPENDIX 2: CLEANER PRODUCTION POTENTIAL





Summary of results SAB

BECO

Process	CP potential environmental benefits (process)												CP potential economic benefits			Estimation of CP potential*			
	Input			Waste / wastewater / emissions					Technology				Costs						
	(Eco-) toxic problem materials	Raw, auxiliary, operating materials	Energy consumption	Solid waste	Special waste	Wastewater (flow, amount)	Wastewater components	Airborne emissions	Status of technology	Level of automation	Faulty batches, scrap	Maintenance, servicing, cleaning	Input materials, energy	Disposal, preparation	Maintenance, stoppages	Points average of environmental benefits (process)	Points average of economic benefits (costs)	Environmental CP potential	Economic CP potential **
P1 *Raw material handling*	-	3	3	-	-	1.5	-	3	1.5	-	1.5	-	1.5	1.5	1.5	2.3	1.5	XX	XX
P2 Milling	-	2	2	-	-	1	-	-	-	-	-	-	1	-	-	1.7	1.0	XX	X
P3 Mash Tun	-	2	2	1	-	2	1	-	-	-	1	-	2	-	-	1.5	2.0	XX	XX
P4 Lauter Tun	-	3	1.5	3	-	3	3	1.5	-	-	1.5	-	3	1.5	1.5	2.4	2.0	XX	XX
P5 Wort kettle	-	-	2	2	-	2	-	2	-	-	-	-	-	-	1	2.0	1.0	XX	X
P6 Whirlpool	-	-	1	2	-	2	1	-	-	-	1	-	-	1	1	1.4	1.0	XX	X
P7 Fermenting	-	3	3	3	3	3	1.5	3	-	1.5	-	1.5	1.5	-	-	2.5	1.5	XX	XX
P8 Bottling and packaging	-	3	3	3	-	3	1.5	-	-	-	1.5	-	3	1.5	3	2.5	2.5	XX	XX
P9 Storage	No CP potential anticipated															0.0		-	
P10 *Transport* Goods Employees	Moderate CP potential anticipated Additional analysis of goods transport system recommended. High CP potential anticipated More detailed analysis of the concept for employees transportation is urgently recommended															1.7 4.0		XX XXX	
E1 Process heat	Moderate CP potential for environmental benefits or financial savings. Additional analysis of the process(es) 'heat provision', recommended.															1.1	1.5	X	XX
E2 Compressed air	Low CP potential for more detailed analysis															1.0	1.0	X	X
E3 Refrigeration systems	Low CP potential for more detailed analysis															1.0	0.0	X	-
E4 Energy management	Moderate CP potential for environmental benefits or financial savings. Additional analysis of the energy management system recommended.															2.3	1.5	XX	XX
Safety, health, material handling	Low CP potential for more detailed analysis															0.8		X	

* *Estimation of CP potential*

X	*low CP potential*	*Points average "environmental benefits" or "economic benefits"*	*0.0*	*to*	*1.3*
XX	moderate CP potential	Points average "environmental benefits" or "economic benefits"	1.3	to	2.7
XXX	high CP potential	Points average "environmental benefits" or "economic benefits"	2.7	to	4.0

** The value of "Process points average" corresponds to the environmental CP potential, the value of "points average of environmental benefits" corresponds to the "Economic potential". *Eco Inspector 2.1*
The calculation of the points average covers all positions with a value. Positions without CP potential (value = "-") are not taken into account. © University of Applied Sciences Basel (FHBB) 2003

APPENDIX 3: REFRIGERATION SYSTEM